A Special Study of Massachusetts Candle Fires during 1999

By Marty Ahrens, Fire Analysis Specialist, Fire Analysis and Research Division, NFPA, and Jennifer Mieth, Public Education Manager, Office of the State Fire Marshal of Massachusetts

Candle fires are on the rise. Firefighters in the field had been telling both authors that the numbers were up, and, a few years ago, Ahrens witnessed a close call herself. A group of friends were just starting to end an evening together in one woman's home. The hostess had created a cozy atmosphere, with several candles of assorted sizes and types on a large, low, wide coffee table. She also had a sweet, old, longhaired cat. As the cat walked by the table, the tip of his tail caught a candle flame. Ahrens yelled "The cat's on fire," successfully stopping all conversation. Another woman, still seated on the couch, was able to pat the fire out before the cat noticed it. Nutmeg was fine, if a little embarrassed. Cats generally haven't learned "stop, drop and roll." Had we not noticed and dealt with the fire before he did, the situation could have turned very serious very quickly.

When Ahrens wrote her first candle fire report for the NFPA in 1998, she confirmed that these fires were becoming more common. Candle fires in the home (one- and two-family dwellings, manufactured housing and apartments) had been decreasing fairly steadily from the 8,240 reported in 1980, the first year of available data, through 1990, when they hit a low of 5,460. Since then, these fires have been increasing steadily, with three consecutive record highs in 1995, 1996 and 1997, the most recent year for which data is available. The 11,600 home candle fires reported in 1997 represent a 41% increase from 1980, and an 82% increase since 1990. In 1997, the 11,600 reported home candle fires caused 156 civilian fire deaths, 1,202 civilian fire injuries, and $171.1 million in direct property damage. Record highs for civilian (not fire service) deaths and injuries, and for direct property damage were also seen in 1996 and 1997.

Any steady or sizeable increase in fires and fire losses would be a cause for concern. Home fires from other causes have fallen fairly steadily during this time period, so this increase is even more notable. From 1980 through 1990, candles started 1.1% of home structure fires, on average. In 1997, the candle share was 2.9%.

NFPA derives national estimates of the fire problem by combining two sources, the NFPA annual fire department survey and the National Fire Incident Reporting System (NFIRS). The NFPA survey provides the big picture –– an estimated total of fires, deaths, and injuries by broad property class. The detailed information is derived from NFIRS.

NFIRS provides a great deal of information. Using NFIRS data for the five-year period from 1993 through 1997, we learned that, nationally, almost half of the home candle fires started in the bedroom. More than one-third of these

fires started because candles were left unattended, abandoned or inadequately controlled. Another one-fifth occurred because some form of combustible material was left too close to the candle. December had twice the number of home candle fires as an average month. The National Candle Association (NCA) reported that candle sales increased dramatically during the past decade, and that the winter holiday season was the peak time for sales.

These statistics were useful, but like most useful research, they raised more questions. What *types* of candles were involved? How old were the people having these fires? Were they male or female? Although "unattended" showed up as the leading cause, that wasn't enough information. For a fire to start, either the candle's flame or its heat had to ignite some other material. Only one ignition factor per incident was available from NFIRS. We wanted more information about the candle-users, and about the products themselves.

The Office of the State Fire Marshal (OSFM) was also concerned about the growing number of candle fires seen in the Commonwealth. Mieth, OSFM Public Education Manager, was appalled to discover that no standards exist for the manufacture of candles or candle holders. There had been reports of glass votive candleholders shattering. The Massachusetts Fire and Safety Education Task Force (Task Force), comprised of a number of Massachusetts fire educators, wanted better information to target public education efforts. In order to develop effective public education strategies, better information was needed about whom to target and what message to use. Different messages and outreach would be needed if it was found adults were leaving aromatic candles burning in the bathroom, if teenagers were leaving candles burning unattended in notoriously messy rooms, or if people were falling asleep with candles burning on the bureau. Because Ahrens had worked at the Massachusetts Office of the State Fire Marshal for almost 11 years before joining the NFPA, NFPA collaboration with the OSFM on a special study seemed like a natural idea.

Mieth and Ahrens collaborated on a draft form to collect more information about Massachusetts candle fires. The Task Force also reviewed the form and made suggestions to make it firefighter friendly. Mieth and her staff identified 301 candle fires reported in 1999 through the Massachusetts Fire Incident Reporting System (MFIRS) and mailed a form for each back to the reporting departments. Two hundred and twenty (220), or 73%, of the forms were returned, a fabulous response rate from any group. No additional incentives were provided. The high response rate indicates that the Massachusetts fire service believed that the candle fire problem was serious and needed attention.

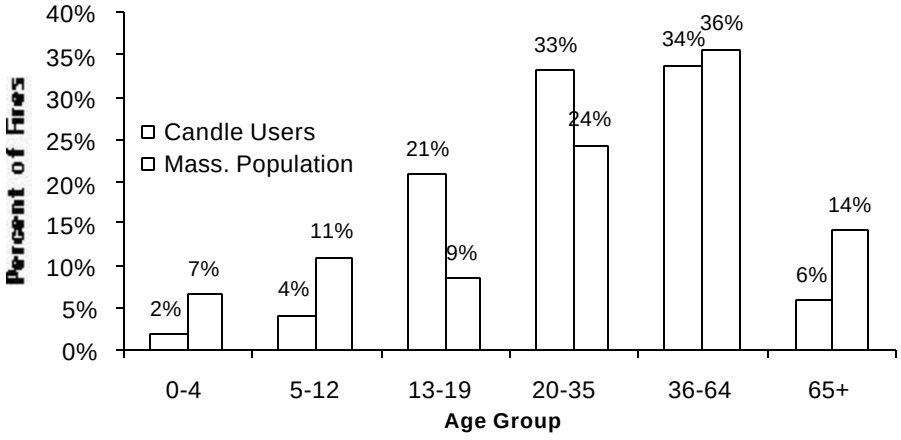
Ninety-six percent of the returned forms were about structure fires; 93% of these structure fires were in one- or two-family dwellings or apartments. The

study data and MFIRS data were linked, making it possible, for example, to identify area of origin by age of candle user without asking the fire departments to duplicate their reporting.

We wanted to know who was using the candles that were involved in fires. We found that 73% of the 196 candle users of known age were over 20 which is very close to the 74% of the population over 20 years old. However, only 6% of the candle users in this study were over 65, although these older adults account for 14% of the population. Two-thirds of the candle users were between 20 and 64, inclusive.

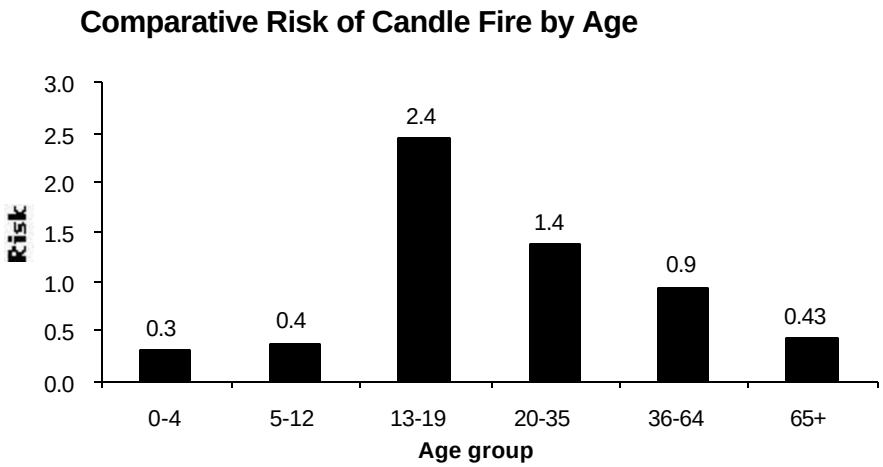
However, teenagers faced the greatest *risk* of a candle fire. Although they comprised only 9% of the population, they accounted for 21% of the fires, meaning they were more than twice as likely to have a candle fire as the population in general.

Candle Users in Massachusetts Candle Fires by Age, Compared to Mass. Population



Mass. 1997 age data from Census Bureau (by MISER's web site on 6/6/00: http://www.umass.edu/miser/population/miserest.html)

Young adults, ages 20 to 35, were the other group identified as having elevated risk, accounting for 33% of the candle users of known age, but only 24% of the state population, giving them a risk one-third higher than the all-ages average. Older adults and children under twelve were much less likely to have a candle fire, one-half and one-third the overall risk, respectively.

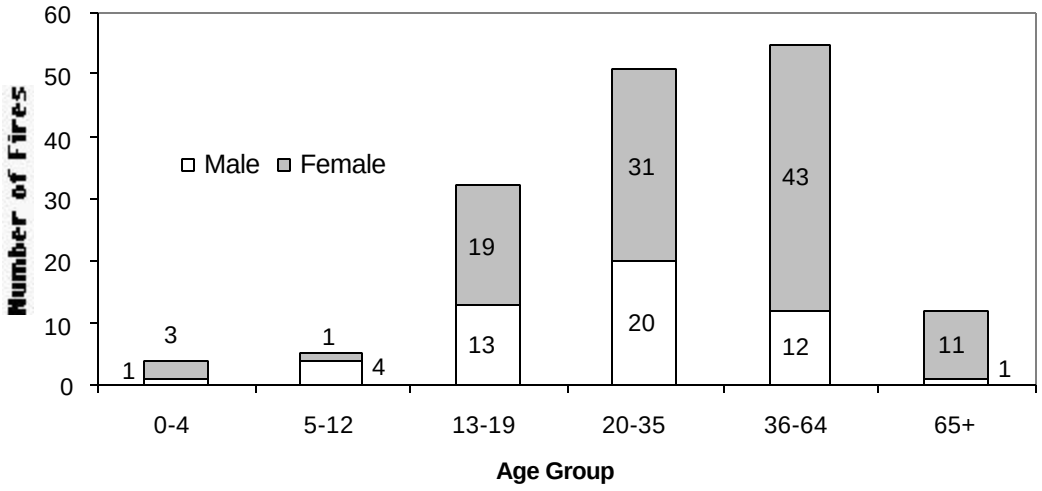


Mass. 1997 age data from Census Bureau (by MISER's web site on 6/6/00: http://www.umass.edu/miser/population/miserest.html)

The National Candle Association reports that candle manufacturers' surveys show that 96% of the people who buy candles are female.* The gender disparity was not as pronounced among the Massachusetts candle-users who suffered fires. About two-thirds (68%) of these 165 candle users of known gender were female; 32% were male. This suggests that males are more at risk, unless males are using a large share of the candles bought by females.

The gender breakdown varied by age group. Among teenagers and young adults, about three-fifths of the candle users in these fires were female. About four-fifths of the 36-64 age group were female; as were about nine-tenths of the people over 65.

Candle Users in Massachusetts Fires, by Age and Sex



The area of fire origin varied with the candle user's age. These differences are probably largely due to where candles are used by the different age groups. When teenagers were involved in the candle fires, 78% (based on 40 cases with known age and area) started in the bedroom.

When the candle users were between 20 and 35, 45% of the 65 incidents with known data started in the bedroom; 18% started in the living room, family room or den; 9% started in the kitchen; and 6% began in the bathroom.

When the candle users were between 36 and 64, 27% of the 66 fires with known data started in the bedroom; 20% started in the living room, family room or den, 15% started in the bathroom; and 11% began in the kitchen.

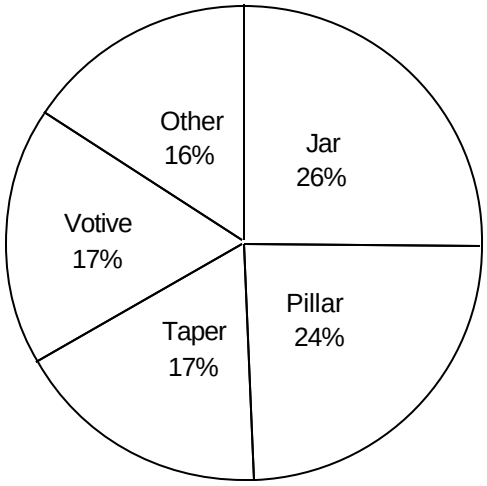
Only 12 fires were reported in the over 65 age group. One-quarter of these fires began in the dining room; 17% started in the living room, family room or den;

* National Candle Association, "Candle Industry Facts" from http://www.candles.org/facts.htm on June 14, 2000

and another 17% started in the kitchen. Only one fire experienced by users in this age group began in the bedroom.

One-quarter of the 126 candles of known type that were involved in Massachusetts fires were jar candles; another quarter were pillars. Votive candles and tapers each accounted for 17% of the incidents. Other candles accounted for one-fifth of the fires.

Massachusetts Candle Fires
by Type of Candle



As mentioned previously, NFIRS data include only one ignition factor. In Massachusetts, fire departments were asked about the major malfunction or cause of the fire, and then asked if the candle was burning unattended. In

three-quarters of the 199 fires with known data, the candle was burning unattended. In NFIRS, "unattended" is one of many choices. As mentioned earlier, we can consider three causes together. Nationally, 19% of the fires were considered unattended, 7% were caused by abandoned material, and 10% were caused by inadequate control of an open fire. Together, these add up to 36%.*

In 5% of the 126 structure fires with known data, candles were being used in more than one room at the time of the fire.

Forty percent (40%) of the 178 candle fires with known data were caused by combustibles too close to the candle. In 35% of the cases, the candle burned down too low. The candle tipped over (on its own) in 10% of the incidents, and was knocked over (by a person, pet or other object) in 7% of the fires. The holder broke in 3% of the cases.

The causes varied by the type of candle used. Almost half of the jar candle fires were caused by combustibles too close to the candle, but this was true for about one-third of the other candles. Consumers may believe that jar candles need less space than other types of candles. This would be an interesting topic for future research.

One-half of the taper fires and 45% of the pillar candle fires occurred when the candle burned down. Breaking holders were factors in jar and votive candle fires only. The table shows the cause of fire by the type of fire for the 99 incidents of known cause involving one of these four types of candles. The number of cases is shown in parentheses next to the type of candle.

Cause of Massachusetts Candle Fires by Type of Candle

Cause	Jar (30)	Pillar (29)	Taper (20)	Votive (20)
Combustible too close	47%	31%	35%	35%
Candle burned down	17%	45%	50%	30%
Holder broke	13%	0%	0%	5%
Candle knocked over	10%	7%	5%	10%
Candle tipped over	7%	14%	5%	0%
Candle flared	3%	0%	0%	5%
Wick was blown off candle	3%	0%	0%	0%
Child held candle	0%	0%	5%	0%
Other	0%	3%	0%	15%
Total	100%	100%	100%	100%

Interestingly, there was relatively little difference between the causes seen for unattended and attended candle fires. As mentioned earlier, three-

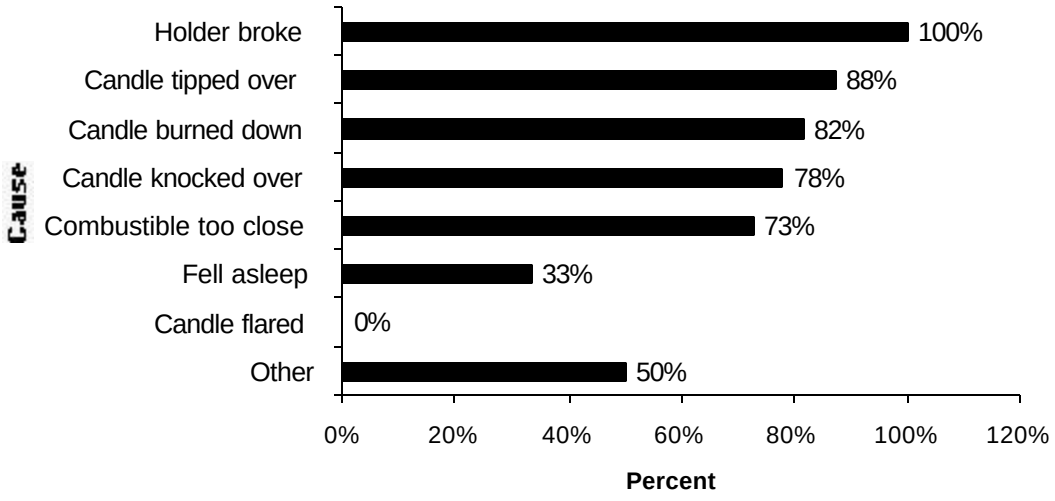
quarters of the Massachusetts candle fires occurred when the candle was unattended.

*****Marty Ahrens, *Candle Fires in U.S. Homes and Other Occupancies: A Statistical Analysis,* Quincy, MA, NFPA, Fire Analysis and Research Division, October 1999, p. 17.

"Combustible too close to heat source" was the leading cause overall, and it caused about an equal share of the attended and unattended fires. Only-one-third of the candle fires that started when someone fell asleep were said to be unattended, yet falling asleep leaves a candle unmonitored or functionally unattended. All of the holders that broke were glass, and it is likely that breaking glass would be noticed if someone was present. Only three of the candle fires were said to be caused by candles flaring; two were attended and attendance was undetermined or unreported in the third incident. The percentages shown in the graph are based on fires in which the cause was known.)

The relatively small difference in cause breakdown between the unattended and attended fires reminds us that just because someone is in the same room with a candle, it does not mean that they are continuously monitoring it.

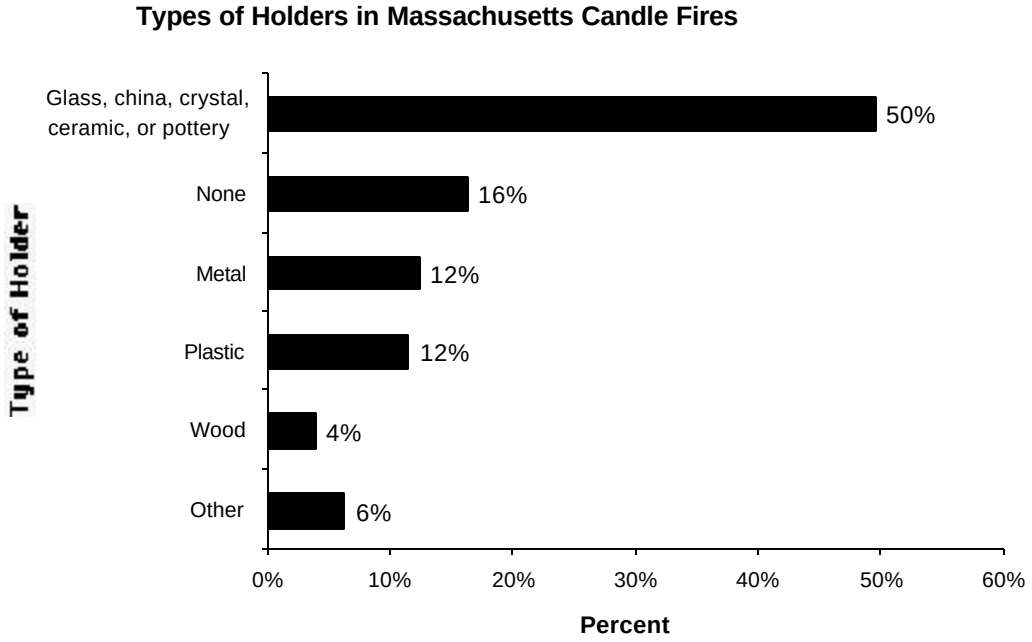
Percent of Massachusetts Candle Fires that Were Unattended, by Cause



The average direct property damage in Massachusetts fires when candles were unattended was $15,200, 35% higher than the $11,300 when the candle was attended. Merely being present when candles are used will not prevent all fires. However, it increases the likelihood that the fire will be discovered when it is still small. This was true in the incident described at the beginning of this article. While birthday candles are usually the center of attention, most other candles are not.

In half of the 129 fires in which information about the candleholder was provided, the holder was made of glass, china, crystal, or pottery. No holders were used in 16% of the fires. The holders were metal in 12% of the incidents, and plastic or Styrofoam in another 12%. Candleholders were made of wood in 4% of these incidents.

The power was out in only 2% of the 212 fires for which this data was known. This means that 98% of the candles were not used in place of electric lights, but were largely used for decoration, pleasure or mood.



About one-quarter of the pillar candles, one-quarter of the tapers, and one-fifth of the votive candles were not in candleholders. Pillar candles accounted for six of the fifteen (40%) candle fires in which the types of candles and holders were both known. Almost all of the jar or bowl and half of the votive candleholders used were glass, crystal, ceramic or pottery. The National Candle Association advises votive candle users to keep the wicks centered and trimmed to 1/4 " to prevent the glass from breaking.*

Candle Holder Type by Type of Candle Used in Massachusetts Candle Fires

Holder Type	Jar or Bowl	Pillar	Votive	Taper	Other	Total
Glass, crystal, ceramic or pottery	32 (97%)	11 (44%)	10 (53%)	3 (25%)	2 (22%)	58 (59%)
Metal	1 (3%)	5 (20%)	3 (16%)	3 (25%)	3 (33%)	15 (15%)
Plastic	0 (0%)	1 (4%)	2 (11%)	2 (17%)	2 (22%)	7 (7%)
Wood	0 (0%)	2 (8%)	0 (0%)	1 (8%)	0 (0%)	3 (3%)
None	0 (0%)	6 (24%)	4 (21%)	3 (25%)	2 (22%)	15 (15%)
Total	33 (100%)	25 (100%)	19 (100%)	12 (100%)	9 (100%)	98 (100%)

The candle industry is large and diverse. According to the National Candle Association (NCA), there are more than 200 commercial, religious or industrial manufacturers of candles in the United States, in addition to numerous craft-

* National Candle Association, "Candle Storage, Use and Safety Tips" from http://www.candles.org/tips.htm on July 25, 2000.

type candle producers. The NCA also estimates that each major candle manufacturer produces between 1,000 and 2,000 kinds of candles.* Candles are also imported. New products are continually being introduced. Consumers expect that the products they buy will be safe. They don't expect a holder to break, and they may not consider whether or not the holder itself can catch fire.

The U.S. Consumer Product Safety Commission has issued a number of recalls of candles and candle-related products. The American Society for Testing and Materials (ASTM) is exploring the possibility of voluntary safety labels on candles and other standards. We need to learn more about who uses candles of what types and how they use them. With this knowledge, public safety educators can better target their messages. Industry may also develop new ways to help protect their customers. If candles self-extinguished before burning down completely, some fires would be prevented. Other people will have other suggestions.

Both the Massachusetts Office of the State Fire Marshal and the NFPA see this study as a first step. Hopefully these results findings will help researchers in future studies refine their questions. There are many issues this study did not address, including the use of novelty candles and the planned use or specific function of the candle (religious or ritual, mood, aroma therapy, general scent, etc.) Other researchers may also wish to explore how the candles themselves burn in different settings, i.e., with open windows, ceiling fans, or when candles are grouped close together. Life safety educators can develop targeted messages about candle safety, but it may also be possible for the industry to develop safer products.

The NFPA and the Office of the State Fire Marshal would like to extent a special thank you to all of the Massachusetts firefighters who participated in this project.

* National Candle Association, "Candle Industry Facts" from http://www.candles.org/facts.htm on June 14, 2000

Massachusetts Tries to Snuff Out Candle Fires
By Jennifer L. Mieth, Public Education Manager, Office of the State Fire Marshal

State Fire Marshal Coan
Recognizing that candle fires nearly tripled in Massachusetts during the nineties, State Fire Marshal Stephen Coan asked the *Mass. Public Fire and Safety Education Task Force* to look into the issue and make recommendations. The Task Force set up a *Candle Subcommittee* that began to research the issue by looking at state and national fire data analyses on candle fires. What room were they starting in? Bedrooms? Dining Rooms? Bathrooms? How were they starting? Were children playing with fire? Were pets knocking them over? Were curtains blowing into the flames? Between the fire data analysis and these firefighters' experience with candle fires in their own communities, they developed five key candle fire safety messages. The Department of Fire Services helped them to create a logo that incorporated the messages into a visually engaging graphic – the candle *Circle of Safety*. The five messages are:

- First, and most important, *burn candles inside of a one-foot circle of safety, free of anything that can burn.*
- Extinguish the candle after use.
- Keep candles out of reach of children and pets.
- Use a saucer or candleholder.
- Never leave burning candles unattended.

State Fire Marshal Coan met with executives from a Massachusetts-based international candle company to discuss ways they might partner with the Department of Fire Services. They explored how the company might educate their customers about candle fire safety and the possibility that they might use and promote the *Circle of Safety* logo within Massachusetts and in national settings.

Partnership with NFPA
The need for more information spawned the idea of the follow-up survey. State Fire Marshal Coan was delighted to partner with the National Fire Protection Association on this project. In order to develop effective public education strategies, we needed to know whom to target and with what message. The follow-up survey was a great opportunity to garner that information as you can read in the main article summarizing the findings.

Need National Standards

In addition to creating the *Circle of Safety* logo, the Candle Subcommittee researched candle company websites for specific fire safety information. They contacted the National Candle Association and learned about the on-going American Society for Testing and Materials (ASTM) process looking into labeling, glass container standards, and wax and wick standards. The labeling work group, it learned, had not one fire and life safety educator as a member. It also had certain legal constraints on the size and content of the safety label. For example, they are required to use an exclamation point inside of a triangle and the word "Warning" making it difficult, if not impossible, to use the circle of safety logo for its required warning label.

They were surprised that there are no standards for glass containers for candles. The average American might falsely assume that any glass candle container would be tempered – designed to withstand high heat - like glass cookware is. This is not always the case, which led the subcommittee to wonder if breaking glassware was a contributing factor to candle fires. Some manufacturers use safe glass, others do not. They also learned that until standards are established in this country for the manufacture of candles, the U.S. Consumer Product Safety Commission cannot require imported candles to meet any safety standards. Once national, voluntary standards are established inside the United States, then importers can be held to those same standards of manufacture and labeling.

The Candle Subcommittee identified several product-related issues that could be addressed by standards including quality of wax, elimination of lead from wicks, glass standards, eliminating the use of combustibles such as dried flowers in candles, and self-extinguishing mechanisms when candles burn down too far, where feasible. The ASTM sub-group is already looking into a number of these issues.

Make Safety Information Easy to Read and Easy to Find

Many candle company websites had fire safety information "hidden" inside general use or general safety tips. On some sites, the list of written safety tips was so long that even public fire educators looking for the fire safety tips gave up reading them. The Candle Subcommittee is hoping that the National Candle Association and its members will consider using the *Circle of Safety* logo because it contains all of the key fire safety points in an eye-catching graphic. In one glance, the consumer knows the top five things they need to know about candle fire safety. The recommendations from the Candle Subcommittee are:

- Make it easier for the public to get the fire safety information;
- Separate out fire safety tips from general use or general safety tips;
- Keep it short;
- Make it visually interesting and easy to read.

State Candle Safety Awareness Day

This year, the Massachusetts Legislature passed a bill that the Governor signed, establishing the second Monday in December as a statewide Candle Safety Awareness Day. The impetus for the day was a first grade at the Nathaniel Morton Elementary School in Plymouth, and their teacher Wendy Longo. They were deeply affected by last December's tragic Worcester fire that took the lives of six firefighters and media coverage reported that the fire was started by misuse of a candle. The first graders asked their state representative to create a candle safety awareness day in memory of the fallen firefighters and to teach everyone in the community about candle fire safety.

Establishing such a day will give fire educators a rallying point around which to focus a candle fire safety campaign. Other potential partners, such as leading candle manufacturers, agree that a Candle Safety Awareness Day would be a great focus for their own customer education efforts.

The work of the Candle Subcommittee, our Fire Data and Public Education Unit and the NFPA has increased our understanding of this important life safety issue and provides direction for our future public education efforts.